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(54) Title: PROCESS FOR IMAGING A FLEXO–GRAPHIC PRINTING PLATE FROM LIQUID PHOTOPOLYMERS AND WITHOUT USING PHOTOTOOLS

(57) Abstract

In the process of making a flexographic printing plate, the liquid photopolymerizable composition is cast against an IR laser–imageable element which then acts as an *in situ* negative for subsequent UV flood exposure.

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PROCESS FOR IMAGING A FLEXO-GRAPHIC PRINTING PLATE FROM LIQUID PHOTOPOLYMERS AND WITHOUT USING PHOTOTOOLS

1. Field of the Invention

The printing industry in general, and the relief printing (flexography) business in particular, are constantly striving to reduce cycle time, and achieve rapid globalization of the information to be printed. This means standardizations, affording to print a given pattern (texts, graphics, etc.) uniformly at any geographical location, worldwide, even for relatively short runs. Such demands of reduced cycle time are best achieved by going directly from a digital file of the pattern to be printed to a final plate, by skipping the huge numbers of steps involved between the pattern/graphics to be printed, and the final plate. The technique commonly used to achieve such short cycle times is known as "Direct-to-Plate".

In the offset arena, companies such a Presstek, Indigo, Xerox, 3M, and others, are offering systems that are successfully addressing above requirements. In the flexography business, DuPont and others are beginning to introduce a Direct-to-Plate, solid sheet, flexographic process, known as "CYREL™ Digital Direct Imaging SYSTEM". (CDDI).

No Direct-to-Plated processes are known in the prior art that use liquid photo-polymeric compositions. This invention addresses the issue of "Direct-to-Plate" via liquids (DPVL) wherein phototools can be eliminated. A very desirable need.

Indeed, while solid sheet flexographic printing plates are easier to use, and therefore, currently predominate, liquid photo-polymeric products have numerous advantages over solids:

1. Environmentally friendly. Easier to recycle than solid sheet compositions.

2. More economical than solid photo-polymeric compositions when compared on a cost per square feet basis.

3. When applied according to best-practice, printing quality can be superior than with solid sheets.

The technical problem in achieving direct-to-plate capability with liquid photo-polymeric compositions, resides in the difficulty to deposit a layer of a stable, laser ablatable coating, on a liquid surface, because of the very dynamic nature of liquid, i.e.: their fluidity that causes intermixing of adjoining layers.

2. Description of the Prior Art

U.S. Patent 4,137,081, 4,442,302, the disclosures of which are incorporated herein by reference in their entirety, describe liquid photopolymers that are actinically imagewise exposed using phototools. Many of the basic teachings in the foregoing patents, concerning the typical use of liquid photopolymers in printing, are applicable to the practice of this invention. U.S. Patent 5,262,275, the disclosure of which is incorporated herein by reference in its entirety, describes solid sheet, UV photosensitive compositions, wherein the top layer is laser ablatable, using computer-guided mechanisms. The laser ablated areas are transparent to UV radiation, whereas unablated areas are opaque to UV. Following laser scanning to obtain the desired pattern, the solid sheet is "flood-exposed" using UV lamps, as is well known in the art. This is followed by development, to achieve the desired printing pattern.

Liquid systems of flexographic plates are well entrenched in the industry, and supplied by companies such as MacDermid, W.R. Grace, Asahi and others, but, unlike with sold sheet flexographic plates, no known techniques are available to make them adaptable for use without phototools (i.d.:via *in-silu* negatives or direct ablation of the desired relief image). This objective is addressed by one of the methods described further.

3. Objectives of the Invention

It is an objective of the present invention to prepare flexographic printing plates that do not required use of phototools or negatives wherein plates are made of liquid photopolymeric compositions as opposed to solid sheets. Further objectives will become known from reading the specifications.

4. Summary of the Invention

The present invention relates to an improved process for manufacturing flexographic printing plates that do not require the use of phototools of the prior art, comprising.

1. Casting a liquid photopolymeric composition against an IR laser-abatable imaging element, which element comprises at least one IR laser-abatable, UV opaque layer sandwiched between two polymeric films, one of which is transparent to actinic radiation.
2. Imagewise scanning the IR-abatable layer with an IV laser.
3. Flood-exposing the liquid photopolymer layer to actinic radiation.
4. Peeling away the IR imaging element to expose the UV flood-exposed photopolymer.
5. Washing away the actinically unexposed liquid photopolymer areas in a suitable developer to obtain the desired relief printing plate, as needed.

5. Brief Description of the Drawings

Figure 1 illustrates an IR laser-abatable layer sandwiched between a non-adherent peelable polyester layer and a UV-transparent support film.
Figure 2 depicts an IR laser abatable layer sandwiched between a polymeric film transparent to IR laser and a UV-transparent support film.

6. Detailed Disclosure of the Invention

The present invention can be carried out according to two general methods:

Method No. 1

The liquid photosensitive layer (usually consisting of a binder, a monomer and negative-acting UV radical polymerization initiator) is cast against a "sandwich" composite (element), instead of a negative or phototool as currently practiced in the art. The construction of the sandwich film is given in Figure 1.

The IR-abatable layer can be vacuum-metallized T, Cu, Al, W, other metals or metal oxides (i.e.: TiO_2,Cu_2O, etc) or carbon lack, that ablated at reasonably low energies and without residues.

Alternately, the IR-ablatable layer may contain a binder such as acrylic polymers and IR dyes that maximize the absorption of IR radiation and its conversion into thermal energy needed to facilitate ablation. Still, another possibility is to simply use IR ablatable dyes, without polymeric binders.

The main essential criteria for the abatable layer are:

1. Opacity in the range of about 700 nm and higher.
2. As thin as possible (preferably in the range of about a few microns to enable ablation at reasonably low energies).

Pore-free

In the process of manufacturing a flexographic plate as per present invention, the liquid photopolymer layer is cast against polyester film (3) Fig. 1), thereby replacing the phototool of the prior art, following current techniques. The peelable top layer (1) is removed and the IR-ablatable coating (2) is "computer scanned" to obtain and *in situ* negative, which is followed by UV-flood exposure, peeling away film (3) followed, if needed, by development as practiced by the prior art.

Preferably, the IR-ablated surface (*in situ* negative) is covered by a protective transparent polymeric film prior to UV exposure. This, to avoid mechanical or other damage during UV exposure.

Method No. 2

This method offers an alternate embodiment of this invention. Specifically, it envisions the formation of an *in situ* mask, without requiring removal/peeling off the upper film covering the "sandwich", as is described in Method #1 In Method #2, the cover film is transparent to the energy delivered by the IR laser without causing optical problems, and therefore, need not to be removed. Alternatively, the top film can be co-ablated with the IR layer. The "sandwich" film is shown in Figure 2.

In the process of manufacturing a flexographic plate according to Method #2, the three layer composite ("sandwich") is placed on the exposure unit, replacing the phototool as practiced in the prior art. IR laser scanning follows, achieving an *in situ* negative by generating a pattern of transparent and opaque areas, as commanded by the computer. UV flood exposure through the *in situ* negative, achieves photo-polymerization where actinic (UV) radiation is allowed to reach the liquid photopolymers through he transparent regions of the *in situ* negative.

Method #2, by necessity, envisions the use of bleachable dyes, as opposed to ablatable coatings. Indeed, due to the presence of the upper film (no peeling-off of the top film is envisioned), ablation could cause problems because volatiles cannot freely excape unless the upper film is porous enough to accommodated the escape of gaseous/volatile produsts ("breathing films"), in which case ablation remains an option.

Again, following IR scanning, the coposite is flood-exposed to actinic (UV) radiation to acieve insolubilization of the areas not to be washed away in the developer. This is followed by peeling away of the bottom film (3) adjacent to the liquid photopolymer that supports the IR coating, allowing development of the final plate, as needed.

Thus, the objective of this invention is similar in scope to that of U.S. Patent No. 5,262,275, except that this invention is exclusively intended for liquid photopolymers. It excludes the use of solid sheet photopolymers.

The method of this invention is summarized the following steps, though modifications thereof, are pracicable by those skilled in the art:

1. Apply adjacently to the liquid photopolymer at least one IR-abiatable, UV-opaque layer supported by a polymer film which is transparent to actinic radiation.
2. Scan imagewise the IR-ablarable layer with an IR laser.
3. Flood expose the liquid photopolymer to actinic radiation.
4. Peel away the film that supports the IR-ablatable layer which is adjacent to the liquid photopolymer without damaging the UV-polymerized regions.
5. Wash away the actinically unexposed liquid photopolymer areas in a suitable developer to obtain the desired relief printing plate, as needed.

CLAIMS

1. A method of manufacturing a flexographic printing element made of liquid photopolymers and imaging it directly without the use of phototools or negatives using IR laser energy, comprising:

   a) Applying adjacently to the liquid photopolymer at least one IR-ablatable, UV-opaque layer supported by a polymer film which is transparent to actinic radiation;

   b) Imagewise scanning the IR-ablatable layer with an IR laser;

   c) Flood-exposing the liquid photopolymer layer to actinic radiation;

   d) Peeling away the film that supports the IR-ablatable layer; and

   e) Washing away the actinically unexposed liquified photopolymer areas in a suitable developer to obtain the desired relief printing plate, as needed.

2. A method in accordance with Claim 1 wherein the IR-ablatable layer is sandwiched between a top-peelable film and a UV transparent film.

3. A method in accordance with Claim 1 wherein the top-peelable film is co-ablatable with the IR-ablatable layer.

4. A method in accordance with Claim 1 wherein the top-peelable film is peeled away prior to the IR-laser scanning.

5. A method in accordance with Claim 1 wherein the IR-ablatable layer is a material that ablates without residues.

6. A method in accordance with Claim 1 wherein the IR-ablatable layer requires energies of 10 mili Joules per cm^2 or less.

7. A method in accordance with Claim 1 wherein the IR-ablatable layer requires energies of 4 mili Joules per cm^2 or less.

8. A method in accordance with Claim 1 wherein the IR-ablatable layer is formed of materials selected from the group consisting of vacuum-metalized metals, metal oxides,carbon black, acrylic polymers containing IR dyes, and IR ablatable dyes.

9. A method in accordance with Claim 8 wherein the vacuum-metalized metals are selected from the group consisting of titanium, copper, aluminum, tungsten and mixtures thereof.

10. A method in accordance with Claim 8 wherein the vacuum-metalized oxides are selected from the group consisting of TiO_2, Cu_2O, WO_2, and mixtures thereof.

11. A method in accordance with Claim 1 wherein the IR-ablatable layer comprises a bleachable dye.

12. A method in accordance with Claim 3 wherein the IR-ablatable layer is a bleachable dye.

13. An imaging element comprising an IR-ablatable layer sandwiched between a top-peelabel film and a UV transparent film.

14. A printing element manufactured in accordance with the process of claim 1.

15. A method of manufacturing a flexo-graphic printing element directly from a liquid phase without the use of phototools or negatives, using IR laser energy, comprising;

(a)providing a layer of liquid photopolymerizable composition capable of being formed into a solid upon exposure to actinic radiation;
(b)covering said layer of said liquid photopolymerizable composition with a UV-transparent film;
(c)applying adjacent said UV-transparent film in contact with said layer of liquid photopolymerizable composition at least one IR-ablatable, UV-opaque layer so that said IR-ablatable, UV-opaque layer will be supported by said UV-transparent film;
(d)imagewise scanning said IR-ablatable layer with an IR laser to ablate portions of said IR-ablatable layer and expose portions of said layer of liquid photopolymerizable composition in said pattern;
(e)flood-exposing pattern-revealed portions of said layer of liquid photopolymerizable composition to actinic radiation to solidify said portions of said layer of photopolymerizalbe composition; and
(f) washing away actinically unexposed liquid photopolymer areas to obtain a desired relief printing plate.

Fig. 1

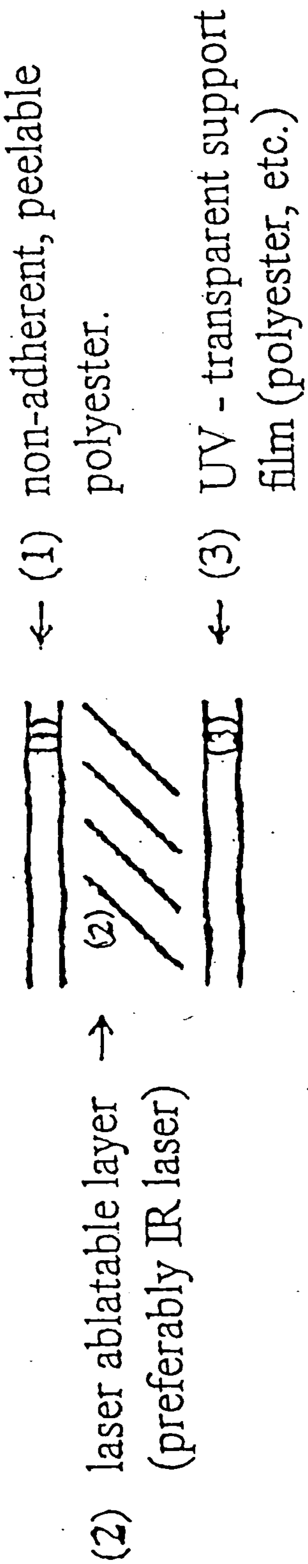
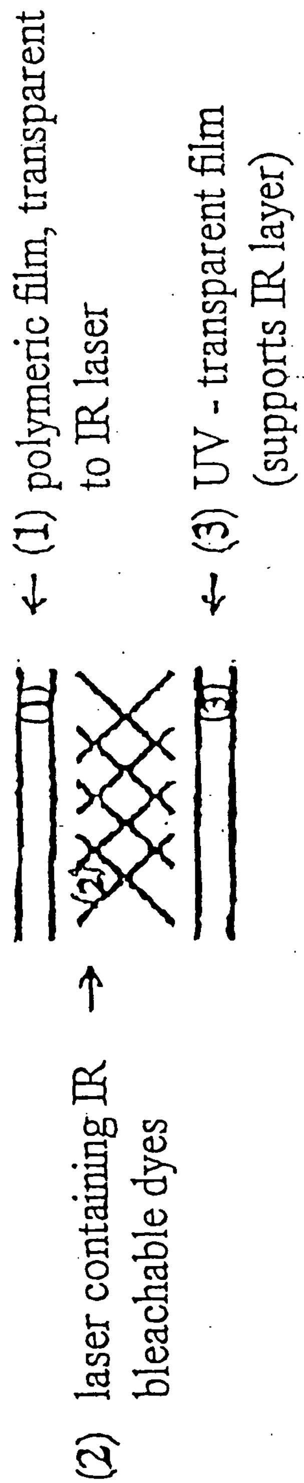

(1) non-adherent, peelable polyester.
(2) laser ablatable layer (preferably IR laser)
(3) UV - transparent support film (polyester, etc.)

Fig. 2


(1) polymeric film, transparent to IR laser
(2) laser containing IR bleachable dyes
(3) UV - transparent film (supports IR layer)

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G03F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G03F B41M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	FR 2 232 781 A (GRACE W R LTD) 3 January 1975 see the whole document ---	1-15 1-15
Y	US 5 262 275 A (FAN ROXY N) 16 November 1993 cited in the application see the whole document ---	1-15
Y	EP 0 634 695 A (GRACE W R & CO) 18 January 1995 see the whole document ---	1
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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International Application No
PCT/IL 97/00330

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5 506 086 A (VAN ZOEREN CAROL M) 9 April 1996 see the whole document -----	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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